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FLOOD INSURANCE STUDY

CITY OF MIDDLESBORO, KENTUCKY
BELL COUNTY

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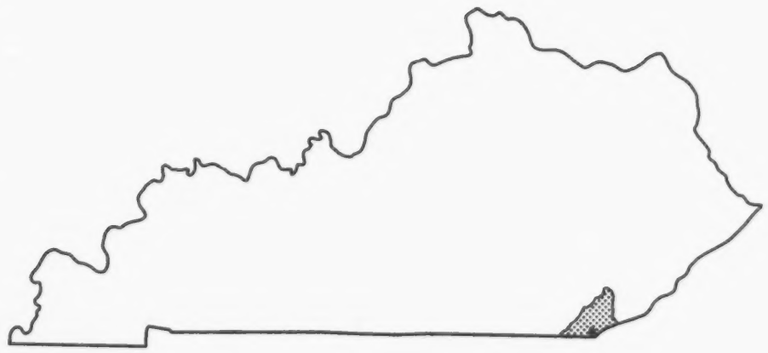

JANUARY 2, 1981

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 215190

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
CITY OF MIDDLESBORO, KENTUCKY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Middlesboro, Bell County, Kentucky and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to maintain the City of Middlesboro in the regular program of flood insurance by the Federal Insurance Administration (FIA). The City of Middlesboro had been converted to the regular program on May 27, 1971. Further use of the information will be made by local and regional plannners in their efforts to promote sound land use and flood plain development.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 24 CFR, 1910.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Mayes, Sudderth and Etheredge, Inc. for the Federal Insurance Administration, under Contract No. H-4063. This study was completed in October 1979.

1.3 Coordination

Streams requiring detailed study were identified at a meeting attended by representatives of Mayes, Sudderth and Etheredge, Inc., the FIA, and the City of Middlesboro in June 1976. The Nashville District, U. S. Army Corps of Engineers (COE), the Kentucky Department for Natural Resources and Environmental Protection, and the Department of Transportation were all contacted for various types of information.

On August 26, 1980, the results of the study were reviewed at the final meeting attended be representatives of Mayes, Sudderth and Etheredge, Inc., FIA and the City of Middlesboro. The study was acceptable to the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Middlesboro, Bell County, Kentucky. The area of study is shown on the Vicinity Map (Figure 1).

The limits of detailed study in Middlesboro were determined by FIA in consultation with representatives of the City of Middlesboro and Mayes, Sudderth and Etheredge, Inc. at the meeting in June 1976.

Floods caused by the overflow of Yellow Creek from the downstream corporate limits of Middlesboro to approximately 1400 feet upstream of the 34th Street bridge were studied in detail. All of the areas within the corporate limits of Middlesboro covered by Bennetts Fork, Stony Fork and Beans Fork were studied in detail. Little Yellow Creek, from it's mouth to the U.S. Highway 25E bridge at river mile 1.56, was also studied in detail.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through October 1984.

No flooding sources were identified in the City of Middlesboro for analysis by approximate techniques.

2.2 Community Description

The City of Middlesboro is located in Bell County in southeast Kentucky, very near the junction of the Kentucky - Tennessee - Virginia borders. The total land area contained within the incorporated area of Middlesboro is 8.6 square miles. It is situated approximately 80 miles northeast of Knoxville, Tennessee, and 135 miles southeast of Lexington, Kentucky.

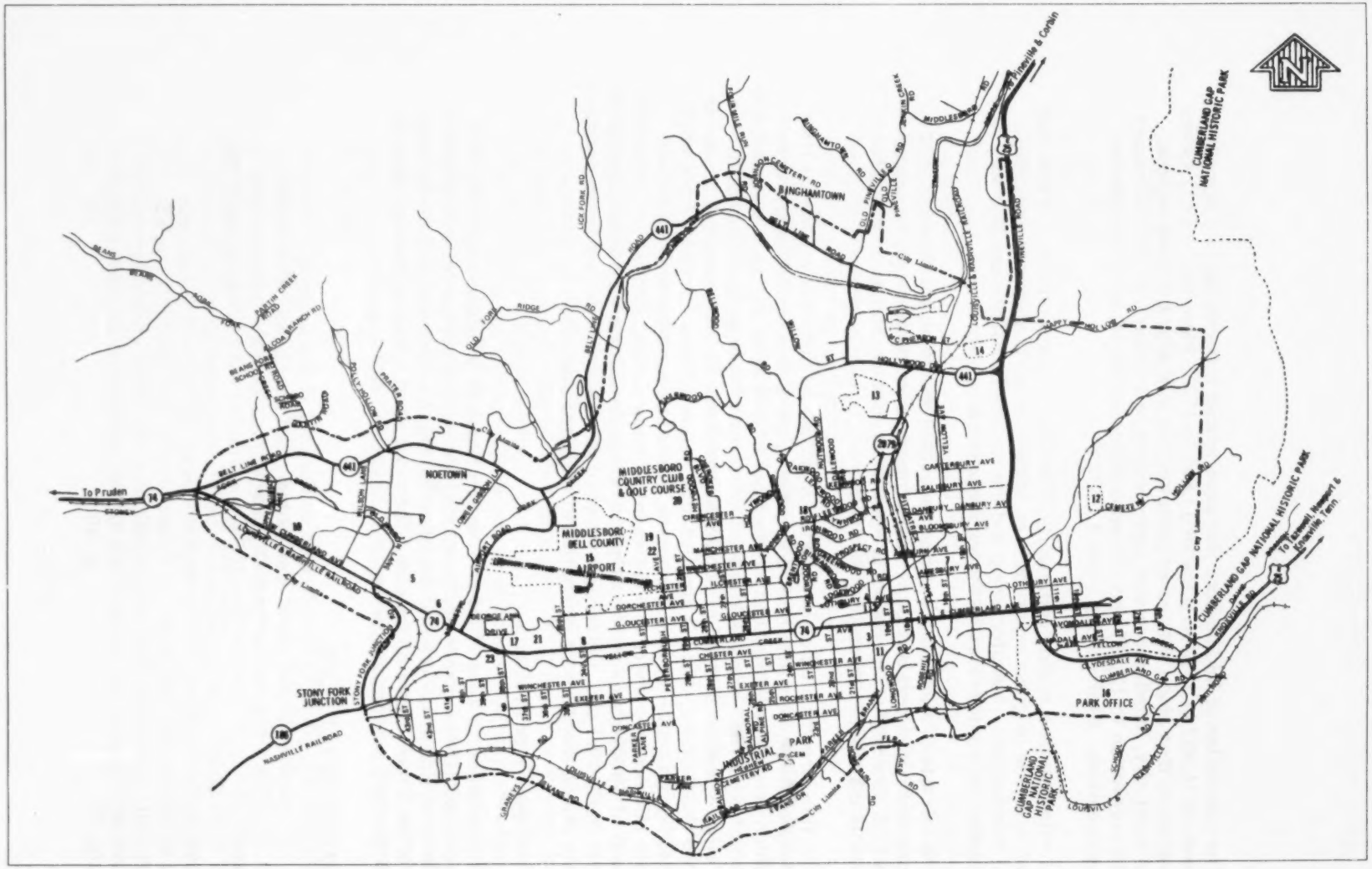


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

VICINITY MAP

The population of Middlesboro had experienced a steady decline since it's peak of 14,482 in 1950 to a low of 11,844 in 1970. However, a 1973 survey indicated that along with other communities in the coal mining regions of Kentucky, Middlesboro was experiencing new growth and had increased it's population to 12,165 giving a population density of 1,400 persons per square miles. (References 1 and 2).

Middlesboro is a mining community. The labor market provided to the coal mines in the neighboring areas in an important part in the economic base of Middlesboro. Manufacturing and the service industries are also very substantial contributors to the local economy.

The climate in Middlesboro can be described as humid, sub-tropical, with long warm summers and short mild winters. The mean annual temperature is 57.2 degrees F. The annual precipitation is about 50 inches and is fairly evenly distributed throughout the year.

The five streams studied in detail in Middlesboro are Yellow Creek, Little Yellow Creek, Bennetts Fork, Stony Fork, and Beans Fork. Yellow Creek, which originates in the southwest corner of Middlesboro, flows in a northerly direction until it empties into the Cumberland River in Bell County. Little Yellow Creek originated in Tennessee and flows in a northeasterly direction into Middlesboro where it empties into Yellow Creek. Bennetts Fork which also has its headwaters in Tennessee, flows in a northeasterly direction into Middlesboro where it empties into Yellow Creek. Stony Fork originates west of Middlesboro and flows easterly into the community where it empties into Bennetts Fork. Beans Fork originates in Bell County and flows southerly into Middlesboro where it empties into Stony Fork.

2.3 Principal Flood Problems

The principal sources of information on floods in Middlesboro are records from two stream gaging stations, one located downstream of the concrete chute on Bennetts Fork and the other at the U.S. Highway 25E bridge over Yellow Creek, north of the city. The most severe floods recorded at each station are summarized below:

Gage on Bennetts Fork

Date	Estimated Peak Discharge (CFS)	Estimated Recurrence Interval (Yrs).
7-24-65	10,900	75
3-22-52	7,200	15
2-01-51	6,580	10
3-22-55	6,420	10
4-04-77	6,240	10

Gage on Yellow Creek

4-04-77	11,700	50
11-28-73	9,980	30
12-30-69	9,980	30
7-24-65	9,660	25
7-25-67	7,920	10

Flooding is aggravated in Middlesboro by brush and trash which snag on the numerous bridge structures and obstructed the passage of water during high flow; this is particularly true on Yellow Creek. Head losses at the bridges on Stony Fork are serious hazards to the safety of the bridges. However, increased flooding resulting from the head losses is not serious because the steep slopes of the stream bed and water-surface profiles limit this effect to very short distances upstream.

A great number of residential, industrial, commercial and social structures are located in the flood plains; Middlesboro has a long history of flooding. Historical floods are well documented in References 3 and 4. Figures 2, 3 and 4 depict some of the damage which has been experienced.

2.4 Flood Protection Measures

The major structural measure for the reduction of flood damage in Middlesboro is a canal and levee system that was completed in 1939. The improvement consisted of a diversion canal and levees around one side of the city, so arranged as to divert most of the headwaters of Yellow Creek away from the old channel through the heart of the city. The total length of the improvement is about 4 miles, beginning on Bennetts Fork at the southwestern edge of the city and ending at Yellow Creek near the Middlesboro tannery at the northeastern edge of the city. The project diverts the floodwaters, which originate in the part of the basin lying north and west of the city, from the principal business district and a large part of the residential section. The floods that caused the greatest damage in Middlesboro came from those portions of the basin.

Channel improvements in 1952 which consisted of clearing and snagging a section of Yellow Creek for a distance of about 3.8 miles below the mouth of the diversion canal substantially improved the backwater problem that had been hampering the effectiveness of the diversion canal. A sizeable increase in channel capacity resulted and stages of large floods were lowered over two feet at the (USGS) gage and from one to two feet in the lower part of the city. Removal of sediment from the upper portion of the diversion canal, completed in 1968, restored the projects ability to pass a 100 year frequency flood with no danger of the levee being overtopped (Reference 4).

FIGURE 2: Middlesboro Industrial Park with the junction of the Diversion Canal and Yellow Creek in the background during 1965 flood.

FIGURE 3: Downtown Middlesboro looking northwest across Cumberland Avenue during 1965 flood.

FIGURE 4: House lodged against 35th Street Bridge across Bennett's Fork during 1967 flood.

Flood flows on Little Yellow Creek and Yellow Creek are attenuated by the effect of storage in Fern Lake; the 100-year discharge on Little Yellow Creek, within the corporate limits, is estimated to be 3,500 cubic feet per second (cfs) as opposed to the 4,700 cfs estimated without consideration of Fern Lake storage.

Flood warning and forecasting services for the entire area are the responsibility of the Nashville River District of the National Weather Service (NWS) in Nashville, Tennessee, with coordination through the NWS River Forecast Center in Cincinnati, Ohio, where most basic forecasts are prepared.

When necessary, forecasts are prepared locally by non-NWS personnel, using advisories from the Nashville River District. The Baxter, Kentucky, water plant superintendent computes and disseminates flood forecast information for the Pineville area.

The forecasts and warnings are given to radio and television stations in the Middlesboro area through releases to the wire service. The Red Cross, Police, Sheriff, State Highway Patrol, and Civil Defense Officers are notified, so that they may prepare for evacuation and rescue operations. in general, warnings of impending floods can be given 6 to 12 hours in advance of flood crests (Reference 3).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, and 500-year period (recurrence intervals), have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50 year period is about 40 percent (four in 10), and for any 90 year period, the risk increases to about 60 percent (six in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in the community.

For Bennetts Fork, the peak discharge-frequency relationships are based on a statistical analysis of a USGS stream gaging station (#03401500) on Yellow Creek Bypass (Bennetts Fork) at Middlesboro (37 years of record). This analysis followed the standard log - Pearson Type III analysis as outlined by the Water Resources Council (Reference 5). The results of the analyses were transposed to the remainder of the stream by the following formula:

$$\frac{Q}{Qg} = \frac{(A)}{(Ag)}^{0.75}$$

Where Q and Qg are discharges at the station and the gage, respectively; and A and Ag are the drainage areas at these locations.

The peak discharge-frequency relationship for Yellow Creek, Little Yellow Creek, Stony Fork, and Beans Fork were obtained by use of the procedure outlined in "Technique for Estimating Magnitude and Frequency of Floods in Kentucky, (Reference 6), published by the USGS. This is a multiple regression method based on flood data at 117 gaging stations in Kentucky and 14 in adjacent states.

The discharges for Little Yellow Creek were modified by reservoir routing to account for the storage effects of Fern Lake located upstream of Middlesboro.

The peak discharge-drainage area relationships for the selected recurrence intervals are presented in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
YELLOW CREEK					
Just upstream Confluence of Bennetts Fork	18.4	3,000	4,500	5,300	7,100
Just upstream Confluence of Little Yellow Creek	4.9	1,500	2,300	2,700	3,700
Just upstream of 24th Street	3.0	1,100	1,700	2,000	2,600
Just upstream of Petersborough Avenue	1.0	500	800	900	1,300

TABLE 1 - SUMMARY OF DISCHARGES- continued

BENNETTS FORK					
Downstream of Corporate Limits	37.8	6,600	10,200	11,900	16,400
USGS Canal Gage	35.3	6,300	9,700	11,300	15,500
Just downstream Confluence of Stony Fork	30.2	5,600	8,600	10,000	13,800
Just upstream Confluence of Stony Fork	13.5	3,100	4,700	5,500	7,600
LITTLE YELLOW CREEK					
At Mouth	11.8	1,900	3,000	3,500	4,750
STONY FORK					
At Mouth	16.7	3,320	5,090	5,870	7,970
BEANS FORK					
At Mouth	2.2	900	1,400	1,600	2,200

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail in the City of Middlesboro were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the flood sources.

Cross sections for the backwater analyses of Bennetts Fork were obtained from the Nashville District of the COE.

Cross sections for the backwater analyses of all remaining streams were field surveyed at selected intervals above and below bridges and culverts in order to compute any significant backwater effects of such structures.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n") used in the hydraulic computations, were chosen by engineering judgement and based on field observations of the streams and flood plain areas. Roughness values for the main channel range from 0.035 to 0.050 while flood plain roughness values ranged from 0.10 to 0.12 for all floods. A roughness value of 0.013 was used for the concrete lined portion of Bennetts Fork.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Water-surface elevations for floods of the selected recurrence intervals were computed for all streams studied in detail through use of the COE HEC-2 Step - Backwater Computer Program (References 7 and 8). Starting water-surface elevations for Yellow Creek were taken from the Bell County Draft Flood Insurance Study (Reference 9). Concurrent peaks were assumed for Bennetts Fork, Stony Fork and Beans Fork. The backwater analyses for these streams were started using the water-surface elevations from the main stem. It was determined that Little Yellow Creek was not likely to peak concurrently with Yellow Creek and was therefore started at normal depth using a slope-area technique. The profile of Little Yellow Creek was drawn so as to reflect that it's profile started at normal depth or the level backwater from Yellow Creek, whichever is higher. All elevations are referenced from the National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown and described on the maps.

In all areas where analyses indicated that supercritical flow would occur, critical depth was assumed. This is a reasonable assumption given the inherent instability of supercritical flow.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using USGS topographic maps (Reference10). All maps were enlarged to a scale of 1:12,000 with contour intervals of 20 and 40 feet. In cases where the 100- and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

With the exception of Bennetts Fork, the floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain, where physically possible (Reference 11). On Bennetts Fork the equal conveyance concept was modified, in some instances, to preserve the integrity of the levee system up to the limits of the 500 year flood; a standard floodway was used from the mouth to the concrete chute. From the chute to the 35th Street bridge, encroachment was used on the eastern overbank to the extent that, at 500 year discharge, the levee at the 35th Street bridge was not overtopped. From the 35th Street bridge to the Winchester Avenue bridge, encroachment was placed at the 100-year boundary on the levee while the western overbank was encroached as far as possible so that the 500 year flood did not overtop the levee; a standard floodway was used upstream of Winchester Avenue bridge. The results of these computations are tabulated at selected cross-sections for each stream studied in detail (Table 2). As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries have been plotted using computed topwidths at cross sections; between cross-sections the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood boundary are either close together or collinear, only the floodway boundary has been shown.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Bennetts Fork								
A	0.07	280	3,005	4.0	1131.7	1131.7	1132.7	1.0
B	0.27	380	3,867	3.1	1133.5	1133.5	1134.1	0.6
C	0.49	360	3,860	3.1	1134.0	1134.0	1134.7	0.7
D	0.78	310	2,902	4.1	1134.5	1134.5	1135.2	0.7
E	1.10	230	1,816	6.6	1136.0	1136.0	1136.6	0.6
F	1.37	107	774	15.4	1140.7	1140.7	1140.7	0.0
G	1.38	114	765	14.8	1144.6	1144.6	1144.6	0.0
H	1.68	156[2]	850	13.3	1148.3	1148.3	1148.3	0.0
I	1.73	241[2]	1,183	9.6	1149.2	1149.2	1149.2	0.0
J	2.12	750[2]	3,976	2.8	1156.1	1156.1	1156.1	0.0
K	2.28	750[2]	4,234	2.7	1157.0	1157.0	1157.0	0.0
L	2.55	241	2,135	4.7	1157.9	1157.9	1157.9	0.0
M	2.77	323	2,847	3.5	1158.8	1158.8	1158.8	0.0
N	2.92	500	3,036	3.3	1159.1	1159.1	1159.1	0.0
O	3.23	500	1,778	3.1	1159.9	1159.9	1160.1	0.2
P	3.38	180	1,571	3.5	1160.2	1160.2	1160.4	0.2
Q	3.50	163	1,147	4.8	1160.4	1160.4	1160.6	0.2
R	3.66	136	554	9.9	1161.4	1161.4	1161.5	0.1
S	3.82	120	671	8.2	1166.2	1166.2	1166.2	0.0
T	3.89	113	471	11.7	1168.5	1168.5	1168.5	0.0
U	3.91	173	1,022	5.4	1171.2	1171.2	1171.2	0.0

[1]Miles above mouth
[2]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

FLOODWAY DATA

BENNETS FORK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Stony Fork								
A	0.27	910	1,499	3.9	1164.0	1164.0	1164.0	0.0
B	0.64	400	851	6.9	1176.3	1176.3	1176.3	0.0
C	0.83	206	1,096	5.4	1183.5	1183.5	1184.0	0.5
D	1.23	82	436	13.5	1206.8	1206.8	1206.8	0.0
E	1.34	130	857	6.9	1214.2	1214.2	1214.7	0.5
Beans Fork								
A	0.07	185	310	5.2	1200.9	1200.9	1200.9	0.0
Yellow Creek								
A	15.16	600	2,967	1.8	1132.6	1132.6	1133.5	0.9
B	15.26	430	4,909	1.1	1132.7	1132.7	1133.7	1.0
C	15.35	200	2,458	2.2	1132.9	1132.9	1133.8	0.9
D	15.57	600	5,009	1.1	1133.2	1133.2	1134.1	0.9
E	15.74	720	5,951	0.9	1133.2	1133.2	1134.2	1.0
F	15.85	550	4,772	1.1	1133.4	1133.4	1134.3	0.9
G	15.94	550	4,532	1.2	1133.4	1133.4	1134.4	1.0
H	16.14	550	4,475	0.6	1133.5	1133.5	1134.5	1.0
I	16.20	425	3,392	0.8	1133.5	1133.5	1134.5	1.0
J	16.26	100	1,173	2.3	1133.6	1133.6	1134.6	1.0
K	16.36	100	1,179	2.3	1134.0	1134.0	1134.9	0.9
L	16.47	150	1,382	2.0	1134.1	1134.1	1135.0	0.9

[1]Miles above mouth

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY

(BELL CO.)

FLOODWAY DATA

STONY FORK-BEANS FORK-YELLOW CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Yellow Creek (cont'd)								
M	16.53	160	995	2.7	1134.5	1134.5	1135.2	0.7
N	16.58	180	1,272	2.1	1134.7	1134.7	1135.5	0.8
O	16.68	300	1,724	1.6	1134.8	1134.8	1135.7	0.9
P	16.89	100	977	2.8	1135.1	1135.1	1136.0	0.9
Q	17.09	280	1,704	1.2	1135.6	1135.6	1136.5	0.9
R	17.42	100	744	2.7	1135.9	1135.9	1136.8	0.9
S	17.63	100	739	1.2	1136.4	1136.4	1137.2	0.8
T	17.77	50	433	2.1	1136.5	1136.5	1137.3	0.8
Little Yellow Creek								
A	0.11	350	1,483	2.4	1133.6	1129.0[2]	1129.0	0.0
B	0.36	175	900	3.9	1133.6	1130.7[2]	1131.2	0.5
C	0.54	200	1,332	2.6	1133.6	1131.8[2]	1132.5	0.7
D	0.69	220	939	3.7	1133.6	1132.6[2]	1133.4	0.8
E	1.01	170	1,332	2.6	1134.8	1134.8	1135.7	0.9
F	1.02	200	1,252	2.8	1134.9	1134.9	1135.8	0.9
G	1.29	200	1,099	3.2	1136.9	1136.9	1137.7	0.8
H	1.54	285	1,491	2.3	1139.4	1139.4	1140.0	0.6

[1]Miles above mouth
[2]Water-surface elevations computed without consideration of backwater effects.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

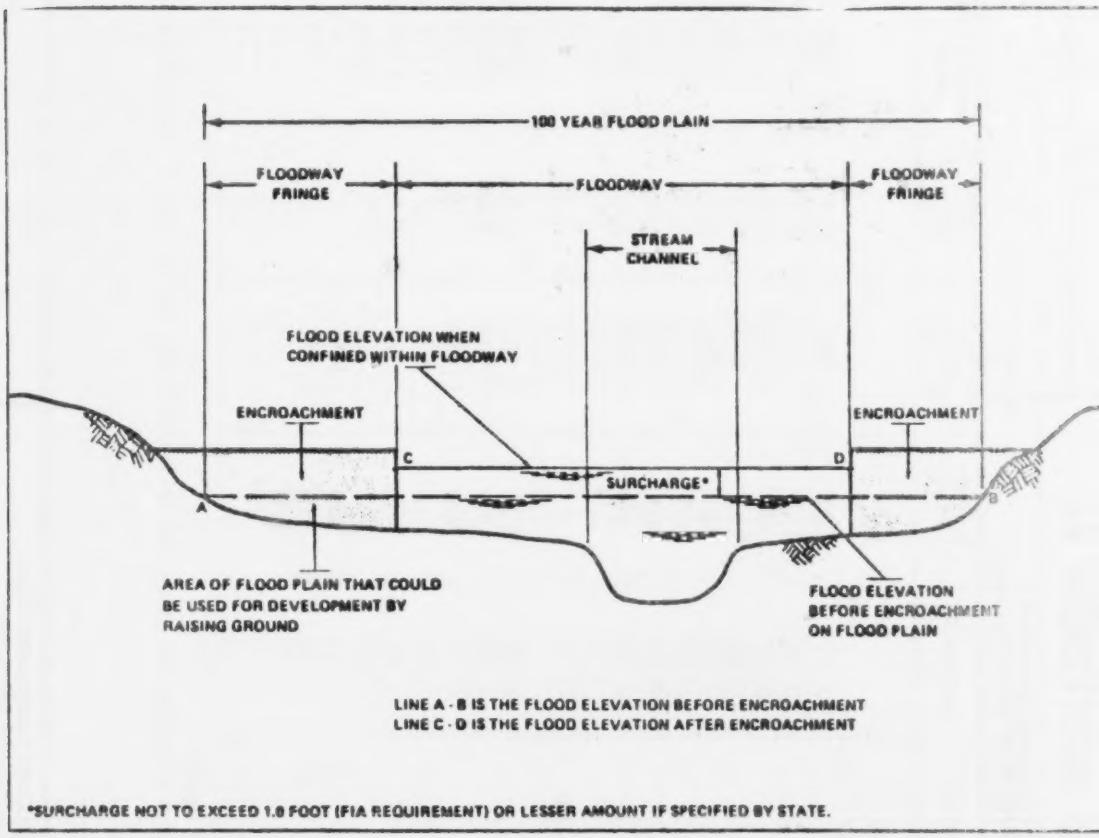
CITY OF MIDDLESBORO, KY

(BELL CO.)

FLOODWAY DATA

YELLOW CREEK-LITTLE YELLOW CREEK

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 5.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 5

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source studied in detail affecting the City of Middlesboro

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 Foot

Seven reaches meeting the above criteria were required for the flooding sources in Middlesboro. These included two reaches each for Bennetts Fork and Yellow Creek and one reach each for Stony Fork, Beans Fork, and Little Yellow Creek. All reaches are shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the City of Middlesboro was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations.

Zones A3, A4, A6, A8	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevation for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Middlesboro is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Bennetts Fork							
Reach 1	0005	-3.0	-0.9	+2.2	030	A6	Varies
Reach 2	0005	-1.9	-0.6	+1.4	020	A4	Varies
Stony Fork							
Reach 1	0005	-1.8	-0.4	+1.0	020	A4	Varies
Beans Fork							
Reach 1	0005	-1.8	-0.5	+0.8	020	A4	Varies
Yellow Creek							
Reach 1	0005	-3.9	-1.1	+3.7	040	A8	Varies
Reach 2	0005	-1.3	-0.4	+2.2	015	A3	Varies
Little Yellow Creek							
Reach 1	0005	-1.6	-0.4	+0.9	015	A3	Varies

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT-SEE MAP

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

FLOOD INSURANCE ZONE DATA

BENNETS FORK-STONY FORK-BEANS FORK-YELLOW CREEK-LITTLE YELLOW CREEK

6.0 OTHER STUDIES

The FIA, Department of Housing and Urban Development, is in the process of completing a Type 15 Flood Insurance Study for Bell County, Kentucky (Reference 9). The study, which is still in draft form as of (May 1979), covers the incorporated areas of Bell County. The Bell County Study and the Middlesboro Study may be compared at two points: 1) Yellow Creek as it flows out of the city and 2) Stony Fork as it flows into the city. In both cases, these two studies agree exactly.

The COE, Nashville District, has completed two studies which pertain to flooding in Middlesboro: 1) a Type 10 Flood Insurance Study (References 12 and 2) a Flood Plain Information Report (Reference 4). This Type 19 Study may be compared to the above two studies throughout, with the exception of Beans Fork, which was not covered in the earlier studies. The profiles in this study are consistently higher than those in the other studies. The difference is due to the hydrologic and hydraulic computations which were performed with more recent information.

This study is authoritative for the purposes of the Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, 1375 Peachtree Street, N.E., Suite 778, Atlanta, Georgia 30309.

8.0 BIBLIOGRAPHY AND REFERENCES

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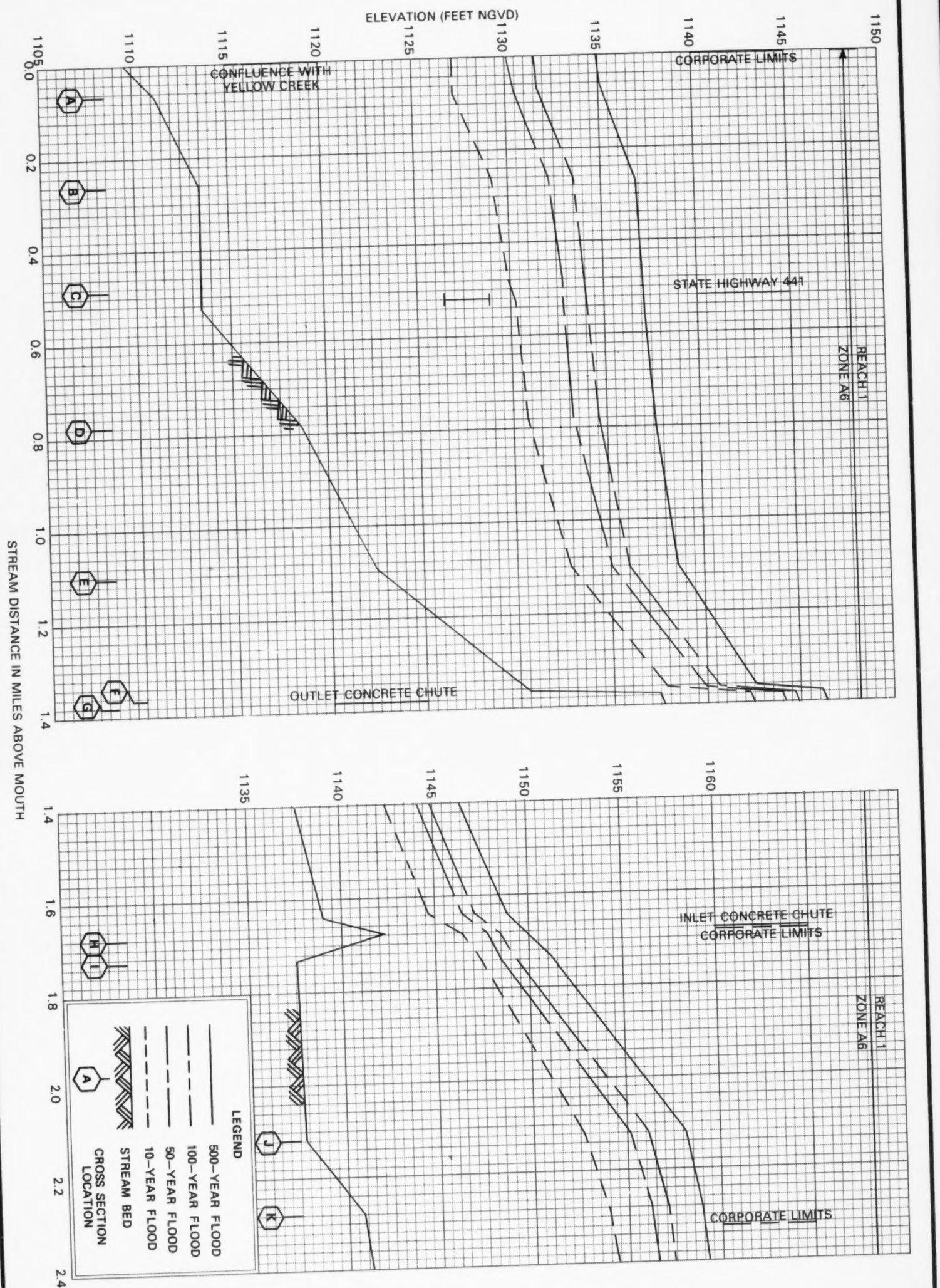


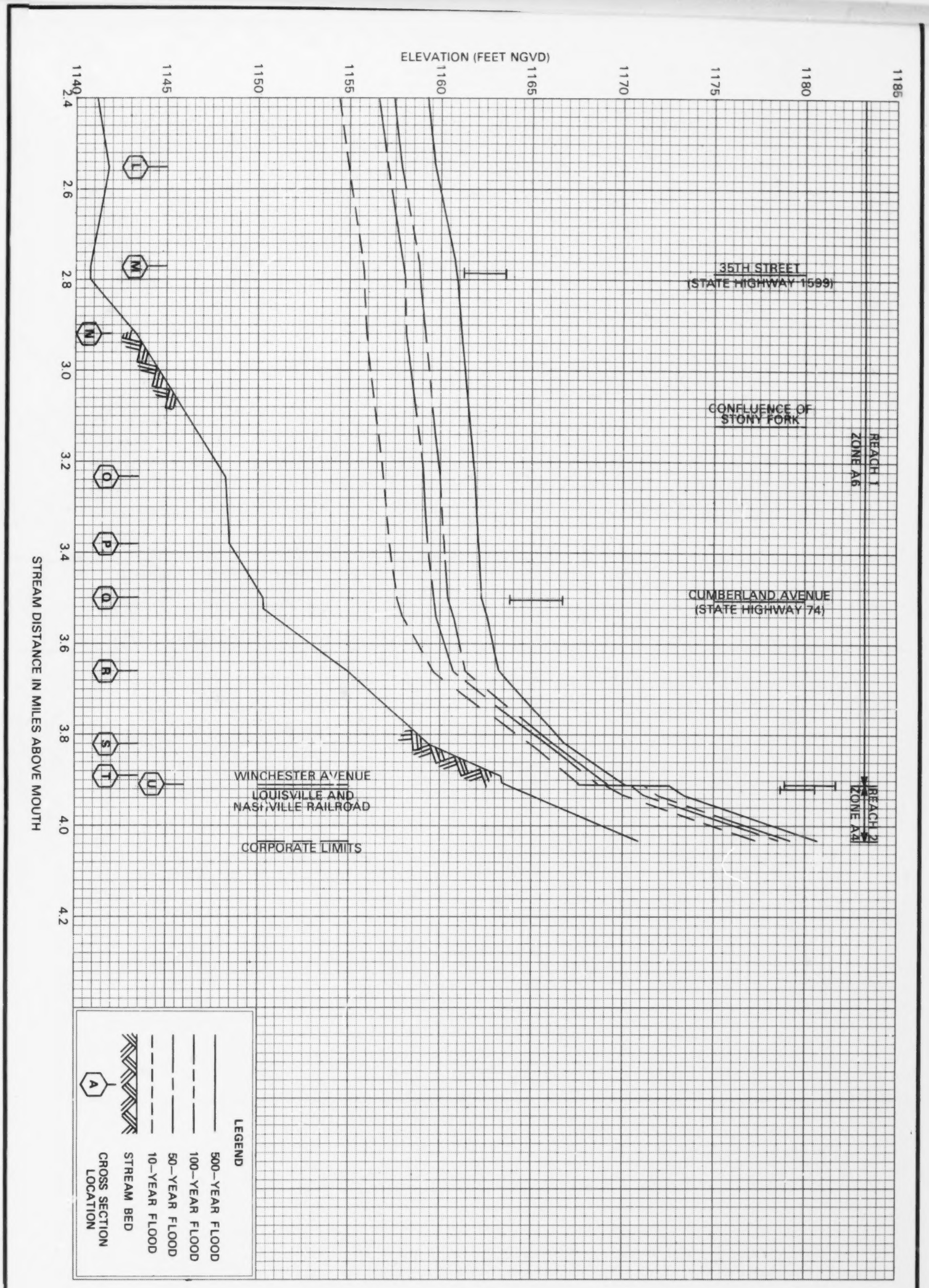
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

FLOOD PROFILES

BENNETTS FORK

01P



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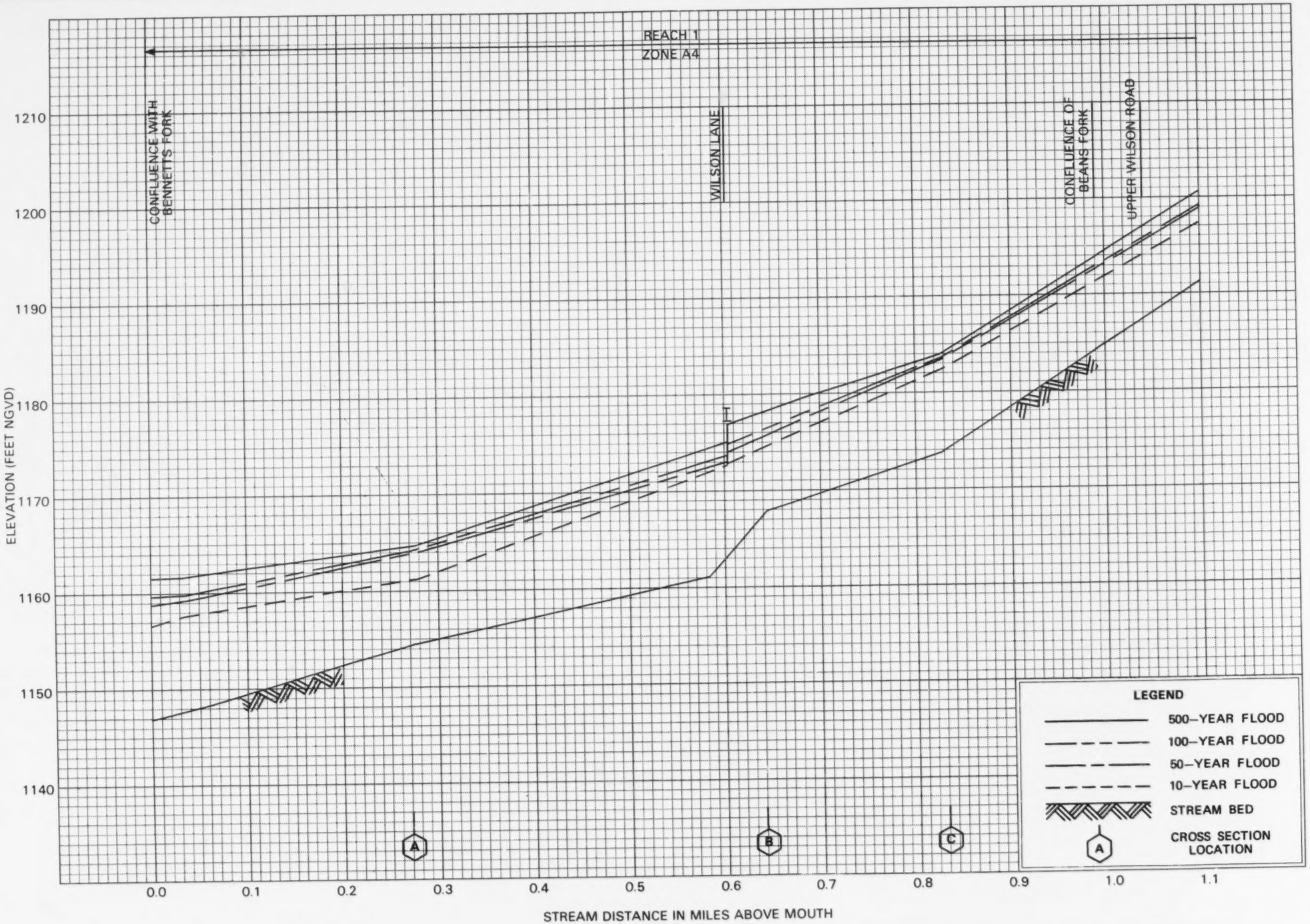
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

FLOOD PROFILES

BENNETTS FORK



FLOOD PROFILES

STONY FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

03P

REACH 1
ZONE A4

CUMBERLAND AVENUE (STATE HIGHWAY 74)

LOUISVILLE AND NASHVILLE RAILROAD

CORPORATE LIMITS

ELEVATION (FEET NGVD)

1230
1220
1210
1200
1190

1.1 1.2 1.3 1.4 1.5

STREAM DISTANCE IN MILES ABOVE MOUTH

LEGEND

- 500–YEAR FLOOD
- 100–YEAR FLOOD
- 50–YEAR FLOOD
- 10–YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

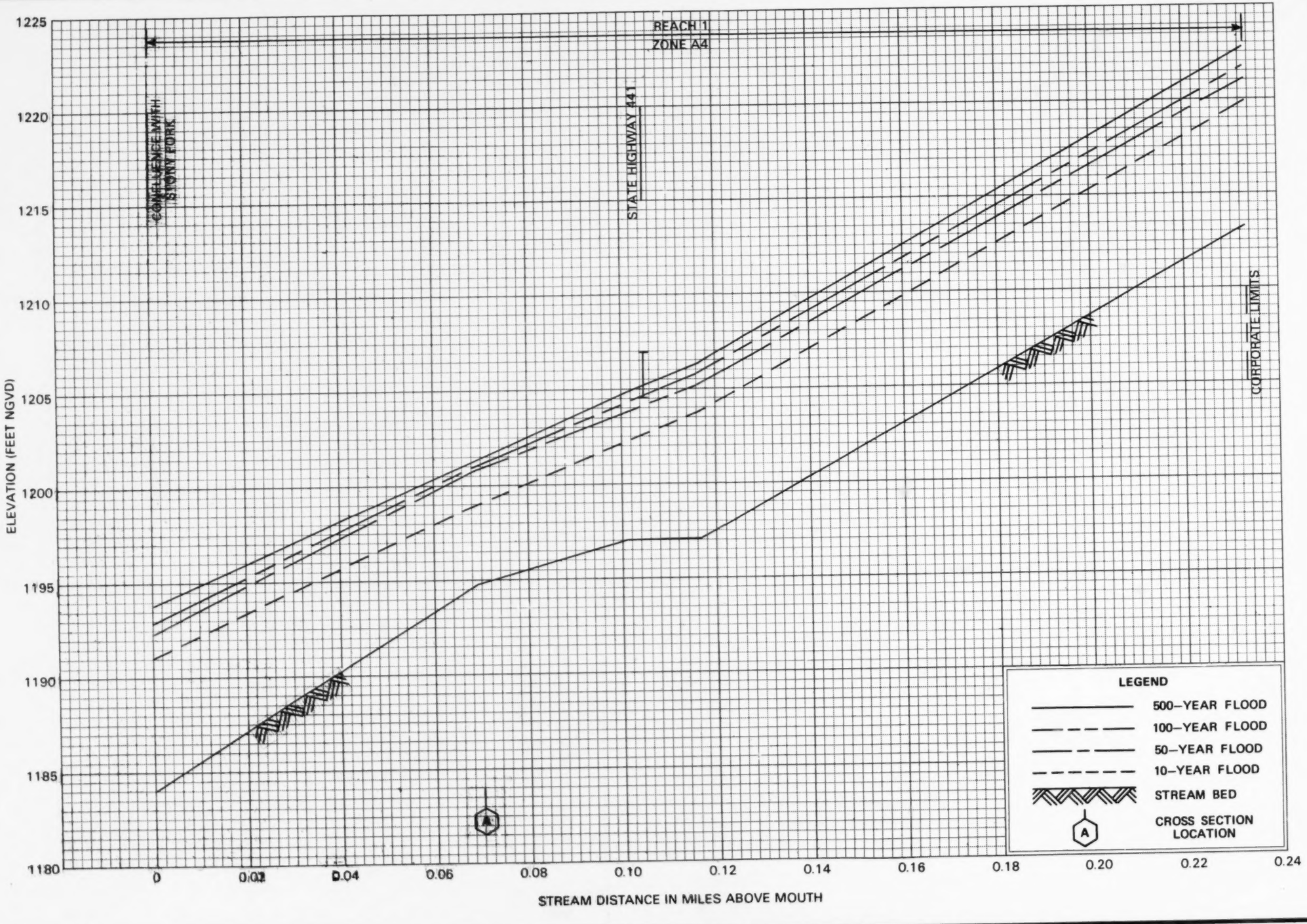
STONY FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY

(BELL CO.)

04P



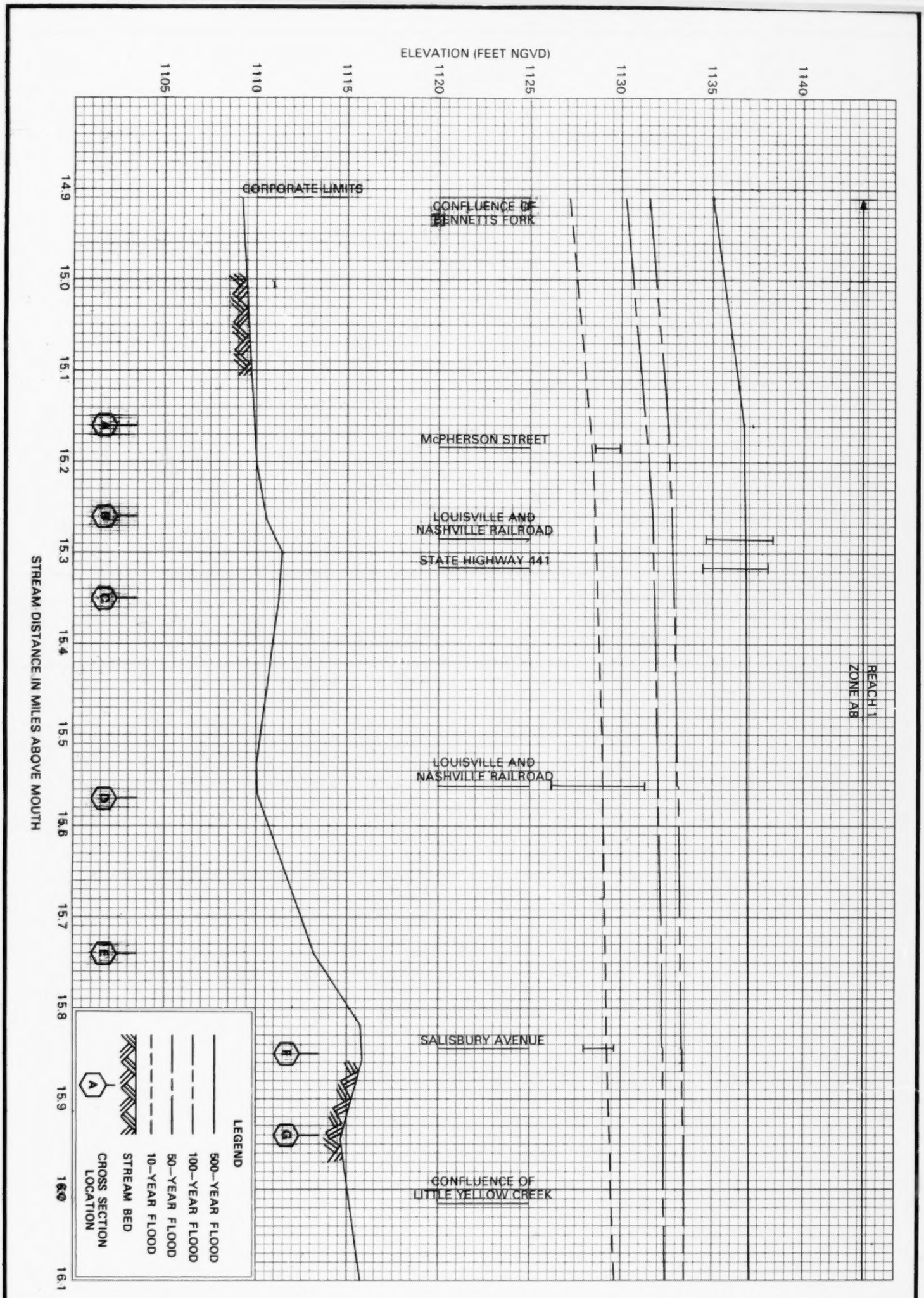
FLOOD PROFILES

BEANS FORK

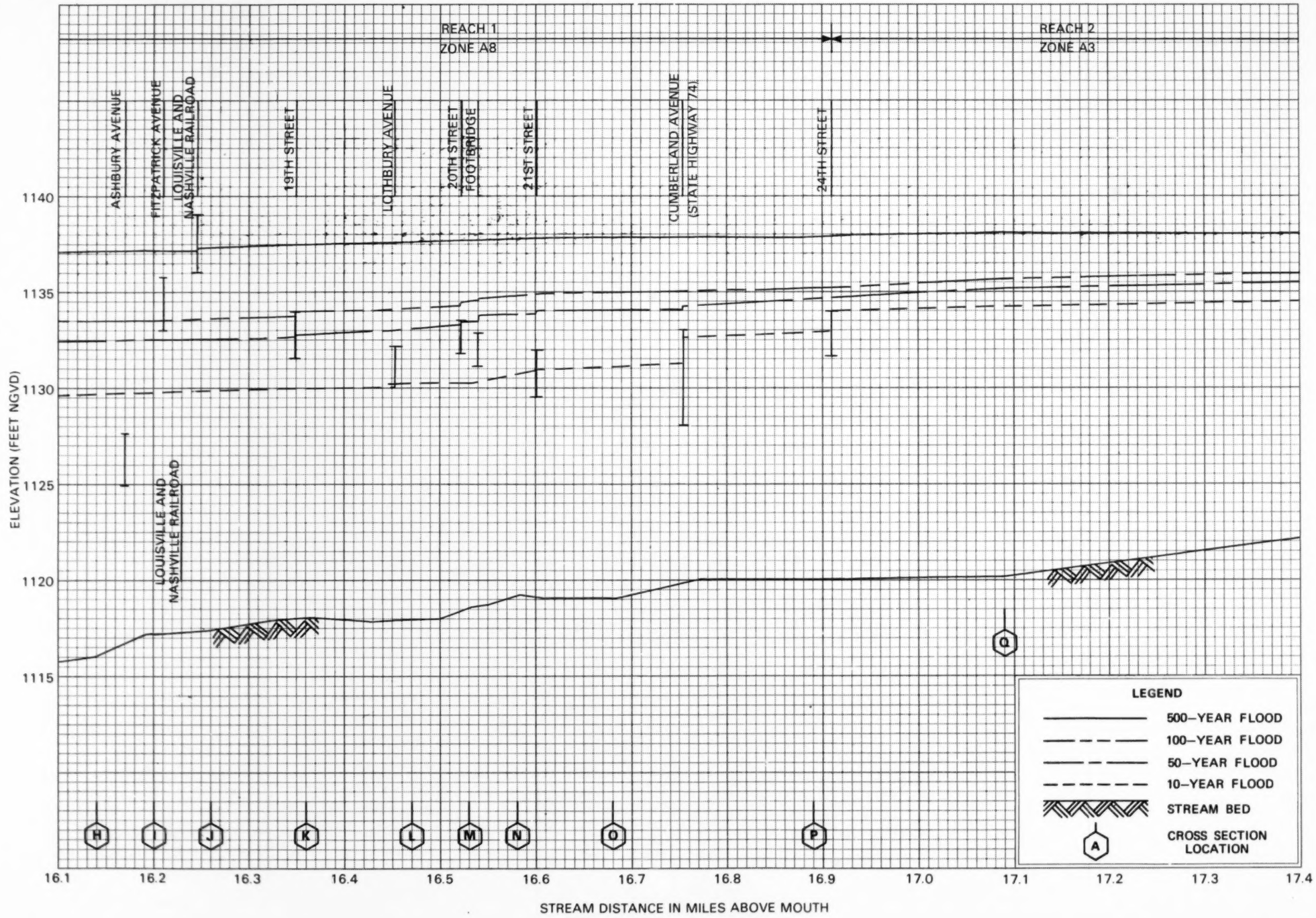
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

05P



06P	FEDERAL EMERGENCY MANAGEMENT AGENCY Federal Insurance Administration CITY OF MIDDLESBORO, KY (BELL CO.)	FLOOD PROFILES YELLOW CREEK



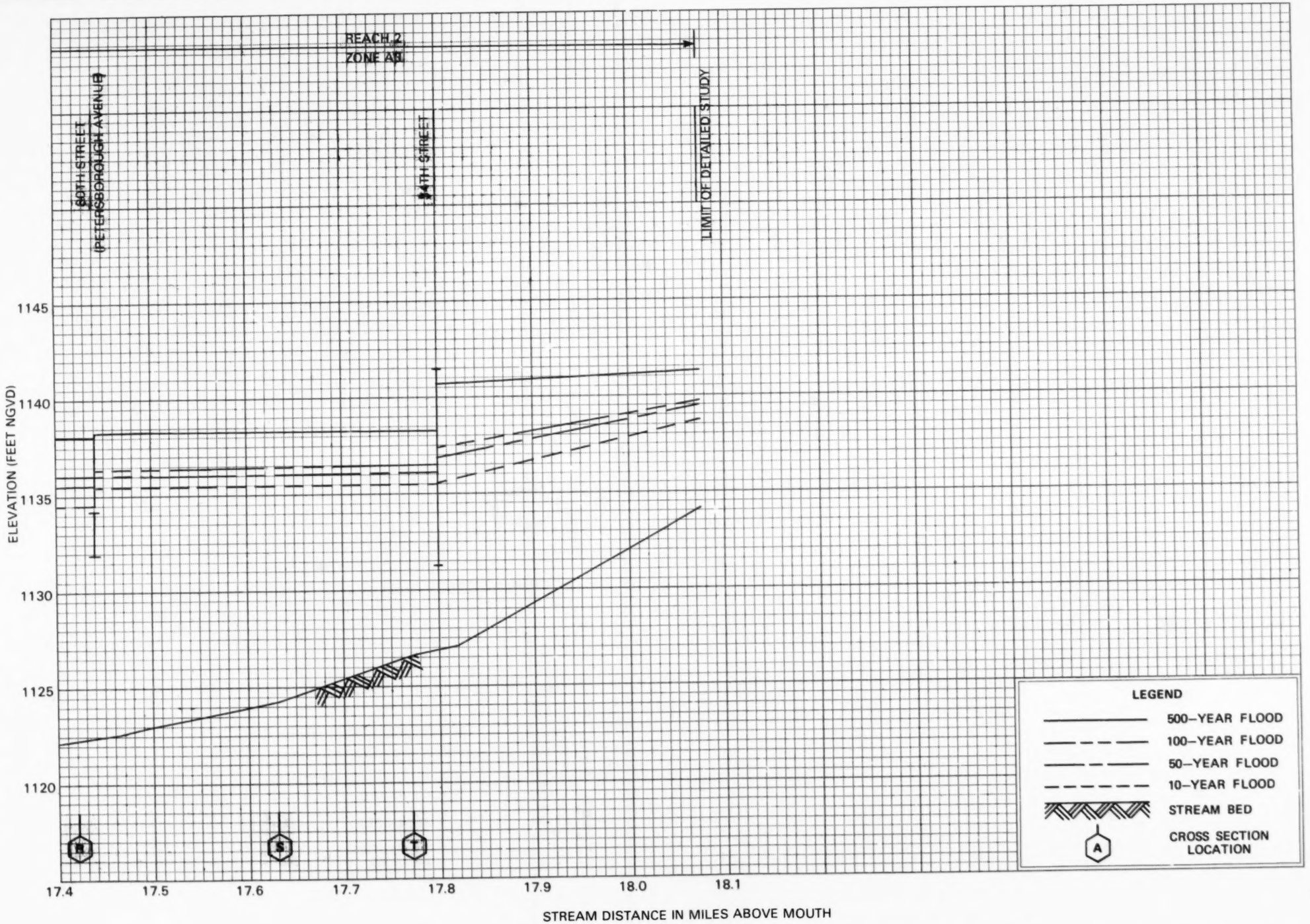
FLOOD PROFILES

YELLOW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

07P



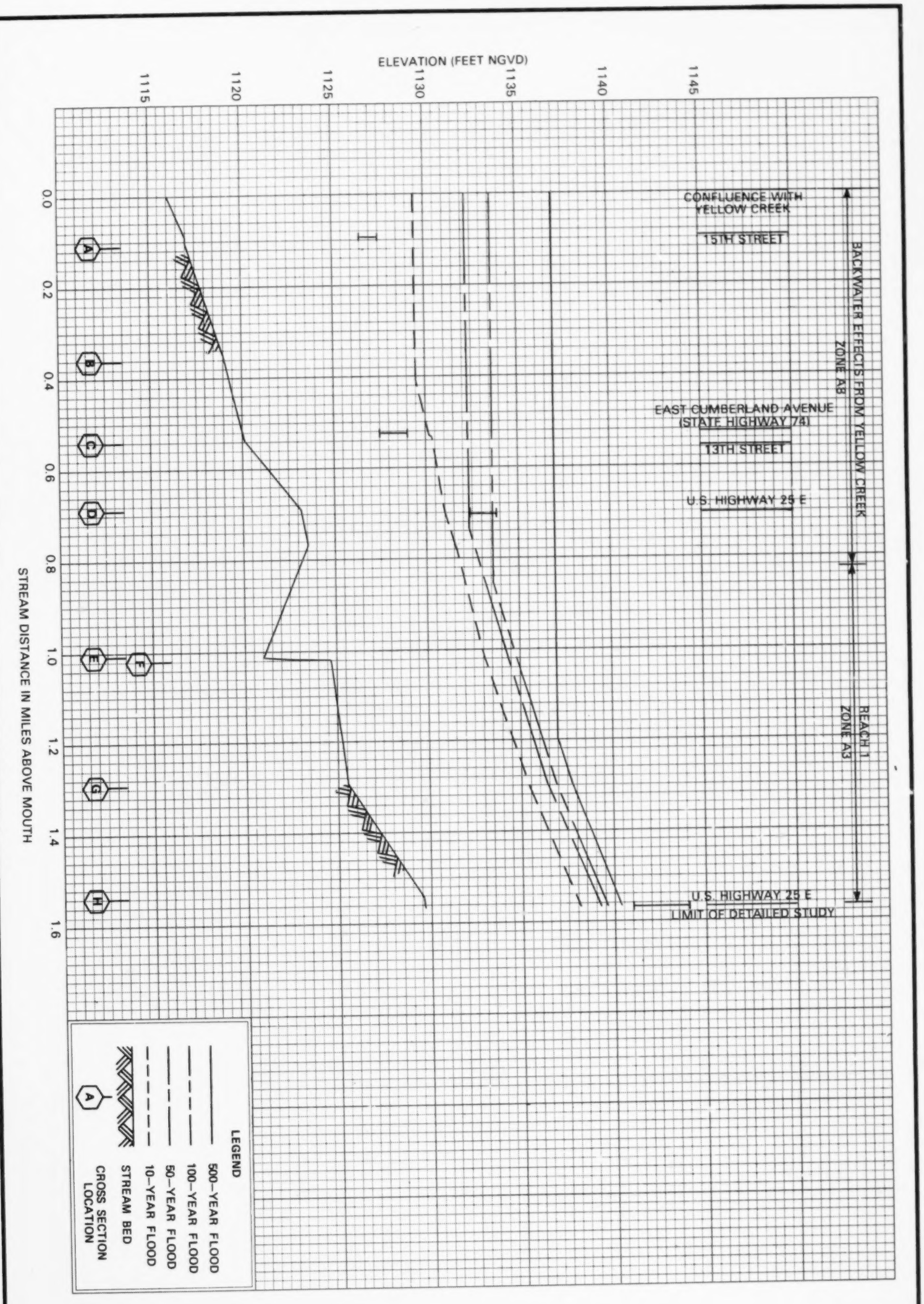
FLOOD PROFILES

YELLOW CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

08P



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FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF MIDDLESBORO, KY
(BELL CO.)

FLOOD PROFILES

LITTLE YELLOW CREEK